MISCELLANEOUS PUBLICATIONS

OF THE

BUREAU OF STANDARDS

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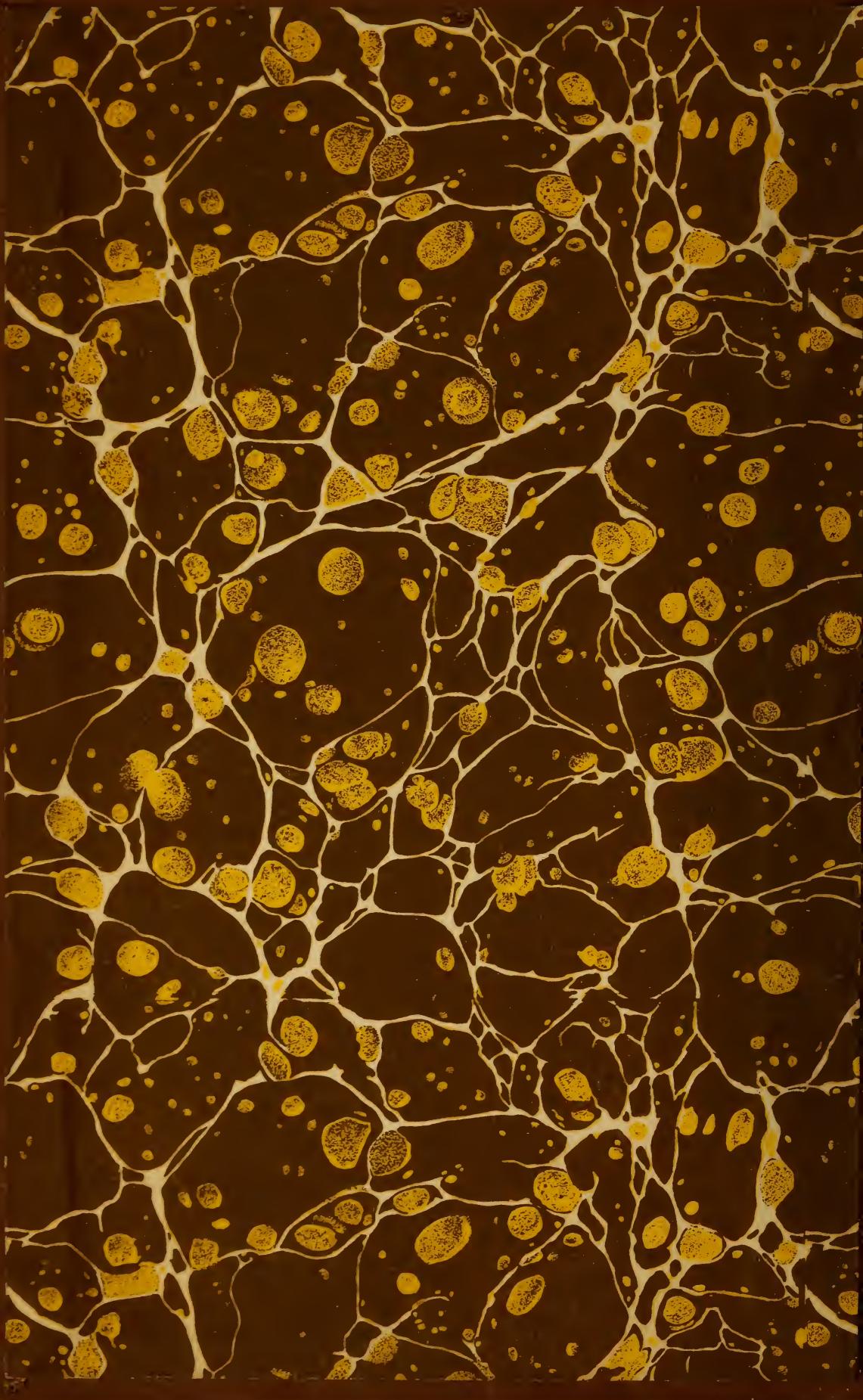

Department of Commerce
Bureau of Standards

Visitors' Manual

of the

National Bureau of Standards

A Brief Account of Its History, Functions, and Laboratory Facilities

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VISITORS' MANUAL OF THE NATIONAL BUREAU OF STANDARDS[1]

HISTORY, FUNCTIONS, AND ORGANIZATION

The National Bureau of Standards was established on March 3, 1901, by act of Congress, taking over the duties of the former office of weights and measures of the Coast and Geodetic Survey. It is charged with the development, construction, custody, and maintenance of reference and working standards used in science, engineering, industry, and commerce. The bureau was originally under the Treasury Department but was transferred to the Department of Commerce and Labor (now the Department of Commerce) in 1903. The original staff numbered 14 and the laboratories were housed in temporary quarters. Now there are about 900 employees, two-thirds of whom are scientifically and technically trained, and the laboratories are among the best equipped in the world. There are 11 major and 7 minor buildings on a site of 43 acres, situated at the intersection of Van Ness Street and Connecticut Avenue in the northwest suburbs of Washington. The altitude of the lower floor of the North Building is 335.69 feet above mean sea level, latitude 38° 56′ 32″ north, longitude 77° 03′ 59″ west. The telephone number is Cleveland 1720.

In addition to the regular staff, there are stationed at the bureau a large number of research associates, sent by manufacturers and industrial groups to work on special problems of interest to the particular industry concerned. The salary of a research associate is paid by the group which he represents; otherwise his status is that of a bureau employee. Results of the work of research associates must be published for the public benefit.

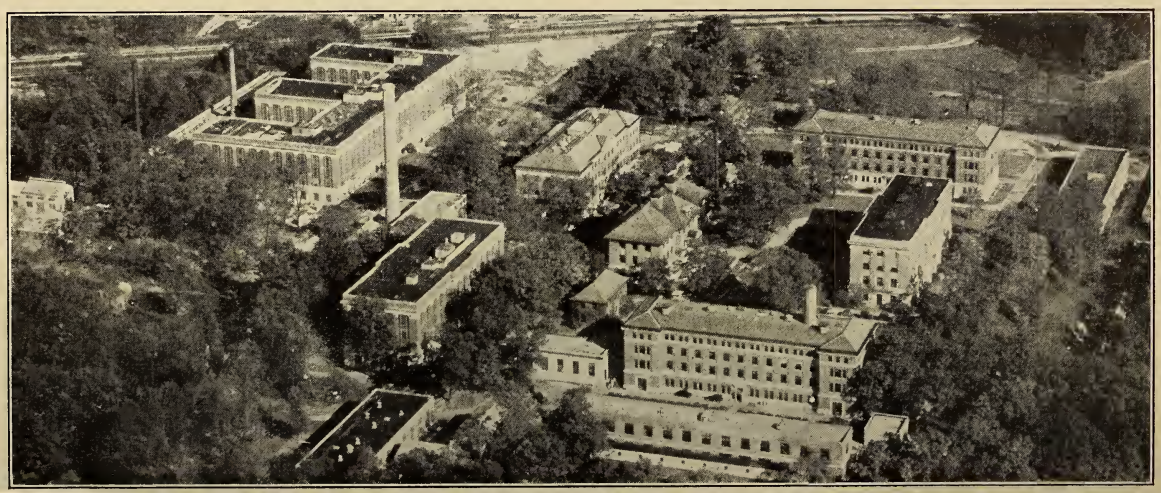
[1] Prepared by Hugh G. Boutell, chief, information section.

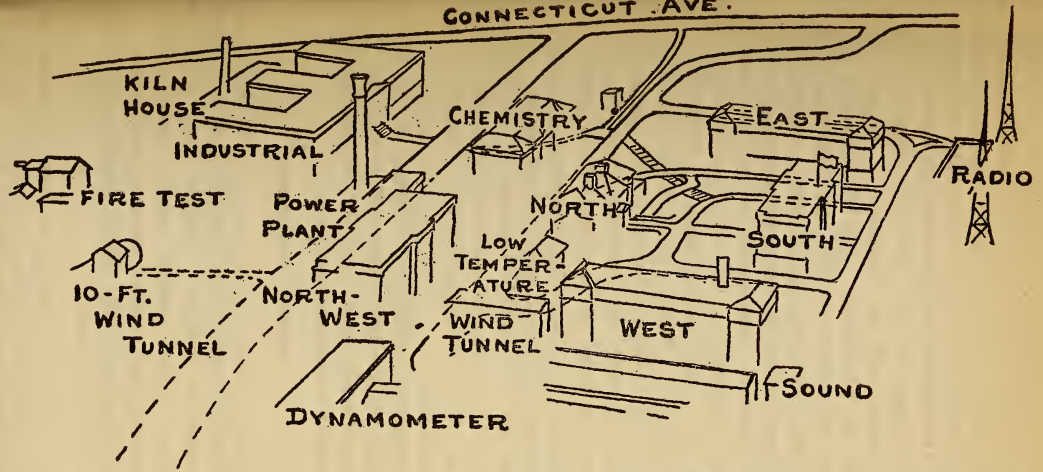
The bureau is organized in three principal groups—the first dealing with research and testing; the second with commercial standards; and the third with the administrative work, operation of plant, and construction of laboratory apparatus.

Location of the Bureau of Standards in relation to a few of the principal streets and public buildings

There are nine divisions of the first group, made up of 65 sections, and five divisions of the second group.

The bureau's services are available to the National and State Governments without charge. Work for the public is undertaken under certain conditions, the main consideration being the value of the work to the Nation as a whole. In the case





Outline key to above airplane view of the Bureau of Standards, showing roads and principal buildings, looking east

of private tests a moderate fee is charged, which, however, is turned into the United States Treasury and is not available to the bureau.

The results of the bureau's investigations are made available through its Journal of Research and by articles in the scientific and technical journals. Other series of papers are also issued covering various phases of the work. A complete list of these papers will be supplied on request to the Bureau of Standards. The publications in the regular series of the bureau are available by purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Bureau of Standards Journal of Research [2] may be obtained from the Superintendent of Documents on a subscription basis at $2.75 per year ($3.50 foreign). Semiannual volumes of the Journal of Research (approximately 1,100 pages), bound in cloth, may also be purchased from the Superintendent of Documents at $2.75 per volume.

Progress of work in the laboratories, important conferences, and new publications issued can be followed in the bureau's Technical News Bulletin,[2] which may be obtained by subscription at 25 cents per year (40 cents foreign) from the Superintendent of Documents.

A complete illustrated description of the Bureau of Standards has been published as Circular No. 1 and may be obtained from the Superintendent of Documents at 50 cents per copy.

POINTS OF INTEREST

The laboratories in the following list have been chosen because they have been found to be of greatest interest to visitors. Likewise they are representative of the bureau's work, which includes fundamental and applied research and testing.

Special arrangements can be made to visit other laboratories not listed.

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[2] Subscription to Bureau of Standards Journal of Research, $2.75 per year (United States, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, $3.50. Subscription to Technical News Bulletin, 25 cents per year; other countries, 40 cents.

A scheduled trip through the laboratories starts from room 302 South Building at 2.15 daily, excepting Saturdays from June 1 to September 30. The bureau is closed on Sundays and holidays. Special arrangements must be made several days in advance for groups of 10 or more. It must be borne in mind that it is only possible, on any one trip, to visit a few of the places listed.

South Building.

Room 101—Mass section.

Weights of many different classes are sent here to have their accuracy determined. The balances used in this work include several of the highest precision. One of these will determine the difference between two weights of about 1 kilogram (approximately 2 pounds) each with an error of less than 1 part in 100,000,000. This section has the custody of the national standard of mass, kilogram No. 20.

Rooms 108 and 109—Dimensional variations.

Investigation of dental materials; expansivity of solids.

Room 114—Interferometry.

A demonstration apparatus is arranged in this room which shows the bending of a 5-inch steel bar under the pressure of one finger. Optical methods are employed by the bureau in making all sorts of precision length measurements.

Room 116—Length measurements in terms of light waves.

Precision screws and dial indicators are calibrated in terms of light waves.

Rooms 201 and 202—Capacity and density.

Tests of glass volumetric apparatus and hydrometers; determination of density and thermal expansion of liquids.

Room 209—Length measurements.

In this laboratory length-measuring instruments of all kinds are checked against the working standards of the bureau. These in turn

South Building—Continued.

have been compared with the national standard—meter bar No. 27—which is kept in the vault on the first floor of this building.

Room 218—Time section.

Watches and clocks are here compared under controlled conditions with the standard clock, which is installed in a special room in the basement. The clock does not vary more than two one-hundredths of a second per day.

West Building.

Room 102—Engineering instruments.

Pressure gauges, water-current meters, anemometers, and fire extinguishers are among the instruments and appliances tested in this laboratory. A standard test for elevator interlocks was developed by this section.

Room 203—Testing of thermometers.

Mercury-in-glass thermometers are compared with the bureau's standards by immersing both instruments in a bath, the temperature of which can be kept at any desired point.

Room 212—Pyrometry.

Very high temperature measuring devices are tested in this laboratory. These include thermocouples, and optical and radiation pyrometers.

Room 306—Optical testing of sugar.

The standard test for purity of a sugar solution is made by means of an instrument known as a saccharimeter. This instrument measures the rotation of a beam of plane polarized light passing through the solution. The bureau also carries out research work on the properties of sugar.

Low-temperature Building.

Room 11—Plants for producing liquid air and hydrogen used in determining points on the low-temperature scale.

Hydrogen has been frozen in this laboratory, the temperature being −438° F. At the temperature of liquid air (−310° F.), the characteristics of ordinary substances are entirely changed.

Low-temperature Building—Continued.

Soft rubber becomes as brittle as glass, lead may be used as a bell, while mercury may be frozen into the form of a hammer-head and used to drive nails.

Wind-tunnel Building.

Main laboratory—Aerodynamics.

One of the three wind tunnels at the bureau, employed in studying the behavior of model airplanes, dirigibles, bombs, buildings, chimneys, etc., in an air stream. This tunnel is 54 inches across at smallest section, and in it a wind speed of 75 miles per hour can be obtained.

Dynamometer Building.

Main laboratory—Automotive power plants.

Investigation of performance of airplane and automobile engines. The bureau is by law the testing laboratory for the Aeronautics Branch of the Department of Commerce. Before commercial airplane engines are licensed by the department they are given an endurance test either in this laboratory or in a special testing plant at Arlington, Va. The most efficient utilization of automotive fuels and lubricants is the general object of a large number of investigations conducted in this laboratory.

Northwest Building.

Basement—Experimental foundry and metal-working equipment.

Alloys can be prepared by melting in electric or other furnaces and cast, rolled, forged, or drawn into the shape desired. The equipment employed is similar to that used in actual mill practice.

Room 105—Microstructure of metals.

The crystalline structure of metals and alloys is studied in this laboratory. The effect of work, heat treatment, corrosion, etc., can be determined.

Room 202—Gauges.

Testing of precision gauges used for controlling the dimensions of machine parts. Optical methods are often used in testing gauges, and their lengths can be determined to one-millionth of an inch.

Northwest Building—Continued.

Room 311—Aeronautic instruments.

Testing of all types of aeronautic instruments for scale errors, effect of temperature and pressure, elastic defects, vibration, and other factors affecting the performance of these instruments. Fundamental research and a certain amount of development work on special instruments are also being carried on.

East Building.

Rooms 106 and 107—Tests of electrical measuring instruments.

Room 109—Heavy current testing.

Tests are made up to 1,200 amperes.

Room 111—Resistance measurements.

The oil bath in which wire standards of resistance are immersed during test includes a special stirring arrangement and temperature control. Precision standards for other laboratories are thus compared at a constant temperature with the standards which represent the bureau's basic unit of electrical resistance.

Room 307—Life tests of incandescent lamps.

Each year several thousand lamps representing Government purchases of from one to two million lamps per year are tested to ascertain whether they comply with the Government's specifications.

Room 314—Integrating sphere for determining the mean spherical candlepower of lamps.

By means of such a sphere the total amount of light given off in all directions by any electric lamp is determined by a single measurement.

Room 317—Tests of radium.

Practically all radium sold in the United States is tested in this laboratory. The rate of radiation is compared with that of a standard sample.

Radio Building.

Main hall—Museum and library.

Model of radiobeacon for guiding airplanes.

Model of piezo oscillator.

Historical electron tubes.

Simple receiving sets, constructed in accordance with Bureau of Standards Circulars Nos. 120, 121, 133, 137, and 141.

French and American radio sets used in World War.

Miscellaneous apparatus developed for research.

Publications, reports, and books.

Chemistry Building.

Room 118—Electroplating.

Specimens of chromium-plated articles and information on chromium plating.

Room 202—Testing of gas appliances.

Domestic burners for natural and artificial gas are tested to determine the efficiency of combustion and safety from production of carbon monoxide.

Room 410—Accelerated tests of paints.

Artificial rainstorms and sunlight as well as temperature changes quickly bring out the weak points of protective coatings.

Industrial Building.

Basement, west end—Cement and concrete testing equipment.

Samples of about 70 per cent of all cement which the Government buys are tested by the bureau.

Basement, center—Large testing machines for structural materials.

The vertical machine on the left, the largest in the world, has a capacity of 10,000,000 pounds in compression. On the right is a 600,000-pound beam-testing machine. In the room next to this machine on the right is the Emery high-precision testing machine with a capacity of 2,300,000 pounds in compression and 1,150,000 pounds in tension.

Industrial Building—Continued.

Room 25—Optical glass.

Examples of glass produced by the bureau. Examination for striæ and strain.

Kiln house, east end—Optical-glass plant.

The bureau operates one of the few plants now making optical glass in the United States. All good glass made here is used by the Navy Department for officers' binoculars, gun sights, periscopes, and similar instruments. Equipment includes machinery for making pots, melting and annealing furnaces, and instruments for determining quality of glass.

Kiln house, center—Furnaces for ceramic material, enameling of metals, etc.; fire tests of wall panels.

Kiln house, west end—Rotary cement kiln and ball mills for grinding cement.

Room 106—Textiles.

The equipment includes a complete cotton mill and representative machines for special work. Tests of textiles and paper are made in a room in which the humidity and temperature are automatically kept constant.

Room 107—Paper.

The bureau has a complete paper-making plant with which improvements in processes and the use of new materials can be studied.

Room 138—Experimental sugar plant for the production of levulose on a semicommercial scale.

The method used for the recovery of this sweetest of all sugars was developed by the bureau.

Room 227—Rubber.

The work of this section occupies several laboratories on this floor and in the basement. Automobile tires are tested for power loss and endurance.

Room 319—Leather.

Samples of leather made from various kinds of hides, including shark skin. Machine for measuring the durability of sole leather. Work on tanning solutions.

A FEW OUTSTANDING ACCOMPLISHMENTS

The National Bureau of Standards—

Constructed the first altitude laboratory for measuring the performance of airplane engines under flight conditions.

Produced the first practicable model of the earth inductor compass, now universally used in long-distance aircraft flights.

Developed the radiobeacon which, in combination with a special aerial and receiving set on the airplane, gives the pilot a visual indication whether he is following the correct course.

Discovered that a thin coating of pure aluminum will greatly decrease the atmospheric corrosion of duralumin, the special light alloy largely used in aircraft construction.

Worked out successful process for plating steel and other metals with chromium, the hardest metal known.

More than doubled the life of printing plates used by the Government.

Developed a new paper for printing United States currency with a life 50 per cent greater than paper formerly employed.

Discovered that certain waste water from paper mills makes a satisfactory material for tanning leather.

Found that by proper treatment Guayule rubber can be made to yield a product as satisfactory for most purposes as Hevea rubber.

Established the dextrose (corn sugar) industry and is now experimenting on production of levulose (sugar from Jerusalem artichokes) on a commercial scale.

Made three standards of planeness flat to within one five-millionth of an inch. These are fused quartz disks about 11 inches in diameter. If enlarged to be 1,000 miles in diameter, the surface would not differ from a true plane by more than 1 inch.

Commenced experiments in making optical glass in 1914 and at last solved the difficult technique, so that optical glass of many grades is now produced as a routine matter. Cast the largest disk of

optical glass ever made in this country—69.75 inches in diameter and 10.5 inches thick; used as the mirror for the Perkins telescope at Ohio Wesleyan University.

Ruled several steel scales directly from light waves, so that there was no measurable error in the finished scales.

Assisted in securing the adoption of a uniform international temperature scale by the International Conference on Weights and Measures.

Published books on house construction, home ownership, zoning regulations, and plumbing requirements.

Helped to reduce unnecessary variety of sizes and styles of articles in common use, securing agreement of manufacturers to concentrate on production of those in greatest demand, thus lowering cost to manufacturer, distributor, and consumer.

Published first directory of commodity specifications and developed certification and labeling scheme for making available to small purchasers the benefits of buying by specification. This includes the preparation of a publication giving names, addresses, and facilities of practically all college and commercial testing laboratories in the United States.

VOLUME OF TESTING

In one year the Bureau of Standards tested approximately—

2,200 electrical measuring instruments.
2,600 electric batteries.
3,600 electric lamps, representing purchases of 1,300,000 lamps by the Government.
2,500 gauges and samples of gauge steel.
6,500 weights and balances.
950 scales.
300 timepieces.
13,000 pieces of glass volumetric apparatus.
570 hydrometers.
4,000 laboratory thermometers.
43,000 clinical thermometers.
2,000 samples of engine fuels and lubricants.

1,700 samples of sugar.
670 samples of radium and radioactive materials representing a sale price of $600,000.
1,200 engineering instruments.
700 aeronautic instruments.
3,000 specimens of engineering materials.
360 fusible boiler plugs.
1,000 samples of metals and alloys.
150 pieces of china and pottery.
12,000 samples of cement and concrete, representing purchases of 1,200,000 ~~pounds~~ barrels of cement.
1,500 miscellaneous samples of ceramic materials.
1,700 samples of rubber.
7,300 samples of textile materials.
2,000 samples of paper.
300 samples of leather.
1,500 samples of paint and varnish.

In addition to the above, 1,200 miscellaneous chemical tests were made and 7,000 standard samples were distributed.